

from said first ring area, and having a sawtooth cross-section in which the diffraction efficiency becomes highest with regard to the mth or - mth diffracted light (m is an integer equal to or greater than 2).

13. (Amended) A projection optical system according to claim 1, wherein said plurality of optical elements constituting said projection optical system have lenses contributing to forming an image of the first plane on the second plane, and all the lenses constituting said projection optical system are constituted of fluorite.

REMARKS

By the present Amendment, claims 1, 3, and 13 have been amended to correct minor typographical errors and claims 7, 10-12 have been amended to more appropriately define the present invention. Applicant submits that no new matter has been added. In accordance with the requirements of 37 C.F.R. § 1.121(c)(1), Applicant provides a marked-up version of the claims in an attached Appendix designated "Version of Claims with Markings to Show Changes Made."

In the Office Action, the Examiner objected to the Abstract because of the term "comprises." Applicants have replaced the term "comprises" by "includes." Accordingly, Applicant respectfully requests that the objection to the Abstract be withdrawn.

As a result of this Amendment, claims 1-29 remain currently pending in this application, with claims 4-6, 15-16, and 22-29 withdrawn from consideration as drawn to a non-elected invention.

In the Office Action, the Examiner rejected claims 7 and 11-13 under 35 U.S.C. § 112, second paragraph; and rejected claims 12, 7-9, 11-14, and 18-19 under 35

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U.S.C. § 103(a) as being unpatentable over Schuster et al. (U.S. Patent No. 6,349,005) in view of Kitagawa et al. (U.S. Patent No. 5,748,372). Claim 10 was rejected as being dependent on a rejected base claim but were otherwise deemed as drawn to allowable subject matter, if rewritten to overcome the rejection under 35 U.S.C. § 112, second paragraph. Claims 3, 17, and 20-21 were allowed. Applicant appreciates this indication of allowable subject matter in the present case.

Rejection under 35 U.S.C. § 112

On page 3 of the Office Action, the Examiner rejected claims 7, and 11-13 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

Applicant respectfully points out an inconsistency between the first paragraph on page 3 (where Examiner denotes that claims 7, 11-13 are rejected) and the second paragraph on page 3 (where rejection of claims 7, 10, and 11 is discussed). With the intention of being fully responsive to the rejection under 35 U.S.C. § 112, second paragraph, Applicant has amended claims 7, 10-12 to clarify the subject matter and amended claim 13 to correct a minor typographical error.

In particular, claims 7, 11, and 12 have been amended to replace "the diffraction patterns" by "diffraction patterns," and further, claims 10 and 12 have been amended to replace the term "element" with "elements," as requested by the Examiner. Claim 13 has been amended to correct a minor typographical error.

Accordingly, for the above reasons, Applicant requests the Examiner to withdraw the rejection of claims 7 and 10-13. Applicant submits that each of the claims fully comply with the requirements of 35 U.S.C. § 112, second paragraph.

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Rejection under 35 U.S.C. § 103(a)

Applicant respectfully traverses the rejection of claims 12, 7-9, 11-14, and 18-19 under 35 U.S.C. § 103(a) as being unpatentable over Schuster et al. in view of Kitagawa et al. because the Examiner has failed to establish a *prima facie* case of obviousness.

To establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a), each of three requirements must be met. First, the reference or references, taken alone or combined, must teach or suggest each and every element recited in the claims. (See M.P.E.P. §2143.03 (8th ed. 2001).) Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to combine the references in a manner resulting in the claimed invention. Third, a reasonable expectation of success must exist. Moreover, each of these requirements must "be found in the prior art, and not based on applicant's disclosure." (M.P.E.P. §2143 (8th ed. 2001).)

Claim 1 recites a projection optical system comprising, a first diffractive optical element arranged in an optical path between a first plane and a second plane; a second diffractive optical element arranged in the optical path on the side of said second plane from said first diffractive optical element; and an optical system having a negative power, arranged in the optical path between said first diffractive optical element and said second diffractive optical element.

Schuster et al. discloses a projection exposure equipment, which comprises an illumination system B and a projection objective P. Id. at col. 6, lines 33-37 and Fig. 7.

The illumination system B comprises a diffractive raster element 9, which forms the

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object plane of an objective 2; and a second diffractive optical raster element 8, which is provided in the exit pupil of the objective 2; and a glass rod 5, which is used to illuminate the reticle 7. Id. at col. 6, lines 44-61.

First, in contrast to Schuster et al., claim 1 recites a *projection optical system* comprising a first diffractive optical element, ... a second diffractive optical element, ... and an optical system having a negative power, arranged in the optical path between said first diffractive optical element and said second diffractive optical element. The diffractive raster elements 8 and 9 in Schuster et al. are part of an *illumination system B* and not a *projection optical system*, as recited in claim 1. Furthermore, the illumination system B is used to illuminate the reticle 7 and is not a projection optical system which forms an image of the first plane on a second plane, as claimed.

Second, as admitted by the Examiner, Schuster et al. does not teach or suggest an optical system having a negative power, arranged in the optical path between said first diffractive optical element and said second diffractive optical element, as claimed. See Office Action at page 4.

Last, Schuster et al. discloses a projection objective P, which is arranged between a reticle mask 7 and a wafer 9; however, this projection objective P consists of group of refractive lenses. Id. at col. 7, lines 13-16. The projection system P does not teach or suggest *any* of the elements of claim 1, namely, a first diffractive optical element, a second diffractive optical element, or an optical system having a negative power, arranged in the optical path between said first diffractive optical element and said second diffractive optical element.

The above-mentioned deficiencies of Schuster et al. are not cured by Kitagawa et al. Kitawaga et al. discloses an objective system comprising a first diffraction type of element (DOE1), a second diffraction type of element (DOE2), and a cemented lens in between the first and second diffraction type of element. Id. at col. 3, lines 42-49. As shown in Figs. 5-7 of Kitawaga et al., the cemented lens system (front group) in between DOE1 and DOE2 consists of either a triplet (Figs. 5 and 7) or two doublets (Fig. 6). While each of the cemented lens system may consist of a negative lens, the cemented lens system in Figs. 5-7 are all optical systems with a positive power. Therefore, Kitawaga et al. neither teaches or suggests at least an optical system having a negative power, arranged in the optical path between said first diffractive optical element and said second diffractive optical element, as recited in claim 1.

Therefore, Schuster et al. and Kitawaga et al., either taken alone or in combination, do not teach or suggest each and every element of claim 1. Furthermore, there is lack of motivation to combine the teachings of Kitawaga et al. with Schuster et al. Kitawaga et al. is directed to an objective system, which does not provide any suggestion for combination with a projection system P of Schuster et al.

In summary, the Examiner has failed to establish a *prima facie* case of obviousness and Applicant respectfully requests that the rejection of claim 1 under 35 U.S.C. § 103(a) be withdrawn and the claim allowed. Claims 2, 7-9, 11-14, and 18-19 are also deemed allowable at least in view of their direct or indirect dependencies from allowable claim 1.

In view of the foregoing remarks, Applicant respectfully requests the reconsideration and reexamination of this application and the timely allowance of the pending claims.

If there is any fee due in connection with the filing of this Amendment, please charge the fee to our Deposit Account No. 06-0916.

Respectfully submitted,

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**APPENDIX TO AMENDMENT OF APRIL 4, 2003
Version with Markings to Show Changes Made**

ABSTRACT

Please replace the Abstract with the following:

In a projection optical system which forms an image of a first plane on a second plane, using extreme ultraviolet illumination light, an object of the invention is to form an image [on] of the first plane on the second plane under suitable conditions. This projection optical system [comprises] includes a first diffractive optical element arranged in an optical path between the first plane and the second plane; a second diffractive optical element arranged in the optical path on the side of the second plane from the first diffractive optical element; and an optical system having a negative power, arranged in the optical path between the first diffractive optical element and the second diffractive optical element.

Amendments to the Claims

Please amend claims 1, 3, 7, and 10-13 as follows:

1. (Amended) A projection optical system which forms an image [on] of a first plane on a second plane, comprising:

a first diffractive optical element arranged in an optical path between said first plane and said second plane;

a second diffractive optical element arranged in the optical path on the side of said second plane from said first diffractive optical element; and

an optical system having a negative power, arranged in the optical path between said first diffractive optical element and said second diffractive optical element.

3. (Amended) A projection optical system which forms an image [on] of a first plane on a second plane, comprising:

a diffractive optical element arranged in an optical path between said first plane and said second plane; and

an optical system arranged in the optical path between said first plane and said diffractive optical element;

wherein when a numerical aperture on the side of said second plane of said projection optical system is designated as NA, an imaging magnification of said optical systems from said first plane to immediately before said diffractive optical element is designated as β , the focal length of said diffractive optical element with respect to a predetermined wavelength is designated as f , and the distance from said first plane to said second plane is designated as L , said projection optical system satisfies the following conditions:

$$1/|NA \cdot \beta| < 0.7$$

$$0.38 < f/L < 1.2.$$

7. (Amended) A projection optical system according to claim 1, wherein all [the] diffraction patterns of said diffractive optical elements are formed on a flat substrate.

10. (Amended) A projection optical system according to claim 8, wherein a filter having a different transmittance according to each ring area is arranged in the vicinity of said diffractive optical [element] elements.

11. (Amended) A projection optical system according to claim 1, wherein [the] diffraction patterns of said diffractive optical elements are formed in a plurality of ring areas centered on an optical axis, each of said respective ring areas having a sawtooth cross-section having a positive power.

12. (Amended) A projection optical system according to claim 11, wherein [the] diffraction [pattern] patterns of said diffractive optical [element] elements is formed in a first ring area and a second ring area, centered on a mutual optical axis, said first ring area being formed on the side of the optical axis from said second ring area, and having a sawtooth cross-section in which the diffraction efficiency becomes highest with regard to the 1st or -1st diffracted light, and said second ring area being formed on the side of the periphery from said first ring area, and having a sawtooth cross-section in which the diffraction efficiency becomes highest with regard to the mth or - mth diffracted light (m is an integer equal to or greater than 2).

13. (Amended) A projection optical system according to claim 1, wherein said plurality of optical elements constituting said projection optical system have lenses contributing to forming an image [on] of the first plane on the second plane, and all the lenses constituting said projection optical system are constituted of fluorite.

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